FAMILY CONSUMPTION OF CERTAIN FRESH VEGETABLES IN HONOLULU

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INTRODUCTION

Individual consumer demand for fresh produce is generated by incomes, produce prices, tastes and preferences, size of family, education, occupation, availability of produce desired, and other variables such as advertising or product variation, and market supplies of fresh and competing produce.

The present study does not pretend to cover all aspects of the factors leading to the purchase of fresh produce, as the survey covered only one month (October, 1951) and prices and market supplies held at relatively constant levels during that time. The effect of incomes, education, racial preferences, occupations, and age composition of the family are, however, capable of analysis in a study of this type. Income is considered important because presumably it is closely associated with the degree of education and the level of occupation, and is reflected in consumer ability to react to changes in price. The analysis shows whether significant differences in consumption are associated with incomes and whether such differences are present among racial groups, families of different sizes, education, and occupations at different levels. The more pertinent findings are perhaps not the determination of differences among the above categories, but the elimination of false effects and the isolation of the true reasons for such differences.

Six vegetables, head cabbage, head lettuce,[1] tomatoes, carrots, cucumbers, and sweet potatoes were chosen as representative vegetables upon which this survey was based. The survey was made to provide consumers, members of the produce trade, and government agencies with information relating to factors influencing consumer demand for fresh vegetables. In addition to this, the study provides a basic definition of the characteristics of the consumer market for vegetables marketed in Honolulu. Further research is under way with respect to other components of the Honolulu fresh vegetable market, including the retail, wholesale, jobbing, and farm levels. This research will include price analysis as a means of establishing price spreads, and cost analysis as a means of determining the costs of performing marketing services reflected in those spreads. The purpose of these studies is to provide the information necessary for recommending improved marketing practices which, presumably, could result in more efficient marketing.

The present, or consumer, phase of the vegetable study concerns itself with providing answers to the following questions:

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[1]Head lettuce, as defined in this study, means the Iceberg type only and not the Manoa (Mignonette) type.

1. What was the net market supply for Honolulu institutions including restaurants and homes?
2. What was the per capita consumption?
3. What effects do the following factors have on household consumption? (a) Gross family income; (b) size of family; (c) racial (national) ancestry; (d) education and occupation of the head of family.
4. What are the consumer preferences for fresh vegetables and what are typical substitutes?

PROCEDURE

Honolulu was the city sampled. The population was stratified by geographic divisions, as both income and racial groups are distributed heterogenously in nearly all sections of the city. Census classifications were used in stratifying. The city is divided into 51 census tracts, and within each tract there are enumeration districts. One enumeration district was chosen at random from each tract. Within each district one street was chosen at random, and if the chosen street had little or no population, another was chosen as a replacement. Houses were also chosen at random, and after the first selection every third house was taken. If a housewife was not at home for the interview, three return visits were made before an alternate household was chosen. This sampling technique yielded 810 interviews.

Accepted statistical methods were used in the analysis of all six vegetables and each was later analyzed separately. As the survey period covered only 1 month, effects of the varying price and supply relationships were largely eliminated. For further discussion of methodology, see Appendix.

HIGHLIGHTS

1. Net market supplies of the six vegetables (head cabbage, head lettuce, tomatoes, cucumbers, carrots, and sweet potatoes) totalled 1,654,300 pounds during October, 1951. This figure excludes military purchases from local merchants and outshipments to the outer islands.
2. During October, 1951, the per capita consumption of the vegetables studied was approximately 5.03 pounds with head cabbage, tomatoes, and carrots leading. The average Honolulu consumer used 1.37 pounds of head cabbage, 1.34 pounds of tomatoes, and 0.83, 0.80, 0.42, and 0.27 pounds of lettuce, carrots, cucumbers, and sweet potatoes respectively.
3. For all vegetables except head cabbage, family consumption increased as family incomes increased. Consumption of head cabbage decreased as incomes became larger.
4. Total family consumption increased as the size of family increased. However, individual members of the larger families consumed less than the members of smaller families.
5. Consumption varied among racial groups; the predominant factor in consumption of tomatoes, for example, was racial preference. Variation among races was also statistically significant for cabbage and lettuce but this variation was largely attributable to differences in incomes among races.
6. Education and occupation were highly correlated with incomes and no statistical method was devised as a means of separating the singular influences of each variable.

7. Homemakers expressed a general preference for a medium size of the six vegetables; liked firm heads of cabbage and lettuce. More families preferred carrots of mainland, rather than of island, origin, but for the other five vegetables, a greater number preferred the island-grown. For all vegetables, homemakers gave good quality and attractive displays as the principal reasons for making unplanned purchases, and the reverse for not buying after they had planned to do so.

GENERAL CHARACTERISTICS OF THE HONOLULU POPULATION

On July 1, 1951, the civilian population of the city and county of Honolulu was approximately 328,426, of which 237,651 were in Honolulu proper.[2] Of this total, approximately 40 percent were of Japanese ancestry, 19 percent Hawaiian or part-Hawaiian, 17 percent Caucasian, 7 percent Chinese, 13 percent Filipino, and 4 percent other races. The racial groups show little tendency toward separation into distinct areas; they are freely intermingled in nearly all sections of the city.

CIVILIAN INCOMES

Civilian incomes in Honolulu are relatively high. The average monthly gross income, estimated from survey data, was $370.62 per family. This high family income figure is partly explained by prevailing high wage and salary scales, but the number of persons working per family is also significant. The average Honolulu family consisted of 4.6 members, of which 1.4 members per family were gainfully employed. Average family and per capita incomes varied significantly among racial groups. The following table summarizes gross-income figures for four major racial groups.

Table I.—Average size of family and monthly gross income of Honolulu families by racial groups.*

ITEM	CAUCASIAN	FILIPINO	HAWAIIAN	ORIENTAL
Average monthly family income	$389.75	$298.57	$329.12	$375.88
Persons per family	3.7	5.2	5.5	4.9
Family per capita income	$104.28	$ 57.10	$ 59.90	$ 76.66

* Estimated from survey data; for estimating formula, see Statistical Appendix, page 19.

EDUCATION OF HEAD OF FAMILY

Of the 810 families surveyed, 39.5 percent completed at least the 8th grade, an additional 25 percent completed business, trade, or high school, and 7 percent completed college. Many family heads attended school, but did not complete the 8th grade.

OCCUPATION OF HEAD OF FAMILY

Approximately 28 percent of Honolulu family heads were employed in skilled service trades,[3] 15 percent in commercial occupations,[4] 14 percent in unskilled service trades and 15 percent in semiprofessional trades. The

[2] Department of Health, Territory of Hawaii, Bureau of Health Statistics.
[3] Service occupations include mechanics, plumbers, electricians, carpenters, and the like.
[4] Commercial occupations include clerks, salesmen, secretaries, etc.

remaining 28 percent were in business or professions, or were retired, or unemployed. Caucasians and Orientals were more likely to be in those occupations that required more extensive schooling. Hawaiians and Filipinos were prevalent in the skilled and unskilled labor vocations.

AGE DISTRIBUTION OF HONOLULU FAMILIES

Of the total population, 20 percent were estimated[5] as being less than 6 years of age, 24 percent from 6 to 19 years, 48 percent from 19 to 50, and 8 percent were more than 50 years old. The relatively high percentage of those under 6, and between 6 and 19, reflects the high birth rate which prevailed in the United States during and following World War II.[6]

TYPE OF STORES FROM WHICH FAMILIES MADE PURCHASES

Grocery and produce outlets in Honolulu were divided into supermarkets, medium markets, small stores, vegetable vendors, and others. Of these, the supermarkets claimed 37 percent of the customers; the medium markets, 23 percent; the small- or family-type stores, 23 percent; and the vegetable vendors, 13 percent. Three percent of the homemakers did not indicate the type of outlet patronized. Many families indicated that they shopped in several types of stores according to convenience, bargains, and custom; consequently, it is difficult to utilize these percentages in approximating the relative volume of trade among the above outlets.

SUPPLY AND PRICE

Gross market supplies of fresh vegetables in Honolulu for 1951 were 67,327,000 pounds.[7] The wholesale value of this supply was approximately $4,643,000, or about 13 percent of the total value of territorial agricultural products, excluding sugar and pineapple. Fifty percent of the Honolulu fresh vegetable supplies originated on the mainland United States, 49 percent in the Territory of Hawaii, and 1 percent in foreign countries. Of the islands comprising the Hawaiian archipelago, Oahu produced 48 percent of the territorial commercial vegetable supply; Maui, 22 percent; Hawaii, 21 percent; Kauai, 8 percent; and Molokai, less than 1 percent.[8]

During the survey month, the six vegetables represented approximately one-half the volume of all market vegetables other than potatoes and onions. Shipments to the outer islands totaling 21,000 pounds reduced the apparent supply for the Honolulu market by a little more than 3 percent of all vegetables received. In addition, purchases by the armed services to augment their direct imports, subtracted about 8 percent from the total received. Armed service purchases accounted for about 15 percent of total cucumber receipts, 9 percent of tomatoes and cabbage, and 6 percent of carrots.

Per capita consumption of the six vegetables, including institutional use, was 5.2 pounds. This figure has an undetermined upward bias because of

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[5] See Appendix for estimating formulas.

[6] *National Summary, Vital Statistics Special Report,* Federal Security Agency, Public Health Service.

[7] *Market Statistics* (Territorial Receipts, Honolulu Unloads, Prices and Shipments of Specified Agricultural Commodities) *1951,* Univ. Hawaii Agr. Ext. Serv.

[8] *Statistics of Diversified Agriculture in Hawaii, 1951,* Univ. Hawaii Agr. Ext. Serv.

the number of tourists and service personnel who patronize Honolulu restaurants.

Retail price ranges were narrow during the survey month, and, in most instances, prices of mainland produce were close to those of the local produce. Sweet potatoes were an exception, as were imports of the cured baker types, while local sweet potatoes were used principally for boiling or luaus.

Table 2.—Six vegetables: Market supply, retail price, per capita consumption and retail value of family purchases, October, 1951.[1]

COMMODITY	NET MARKET SUPPLY[2]	AVERAGE RETAIL PRICE PER POUND[3]		PER CAPITA CONSUMPTION[4]	RETAIL VALUE OF AVERAGE FAMILY PURCHASES
		Island produce	Mainland produce		
	1,000 pounds	Cents		Pounds	Cents
Cabbage	451.0	8.4	—	1.37	54
Tomatoes	440.8	24.5	24.0	1.34	145
Lettuce, all types	273.1	26.9	26.0	0.83	103
Carrots	264.0	(15)	17.6	0.80	55
Cucumbers	136.5	23.4	—	0.42	43
Sweet potatoes	88.9	14.6	24.6	0.27	18

[1] Population estimate, county of Honolulu, 328,426 as of July 1, 1951, Dept. of Health, Territory of Hawaii, Bureau of Health Statistics.
[2] Total supply less military purchases and outshipments.
[3] Data collected weekly from large, medium-sized, and small stores in various areas.
[4] Includes consumption in households, restaurants, and institutions in the city and county of Honolulu. Does not include production from home gardens.

FAMILY CONSUMPTION RELATIONSHIPS

The variables—size of family, gross family income, racial ancestry, occupation, and education—were analyzed for each vegetable and for the total. Paired observations showed such close relationships between race and education, education and occupation, and occupation and income, that it was difficult to isolate the separate effects on consumption except for certain vegetables.

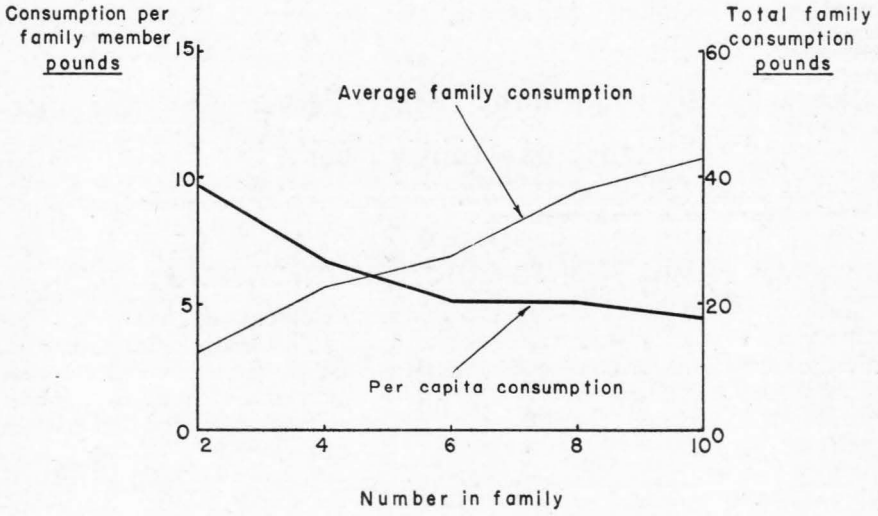
Family consumption increased with the number of persons in a family; but average consumption of family members decreased as the number of persons increased. Part of this decrease is explained by the lower income per family member in large families.

Table 3.—Six vegetables: Consumption and income by size of family, October, 1951.

NUMBER OF PERSONS IN FAMILY	PER CAPITA INCOME	PER CAPITA CONSUMPTION	FAMILY INCOME	FAMILY CONSUMPTION
	dollars	pounds	dollars	pounds
1 to 2	182.30	9.5	273.45	14.25
3 to 4	106.93	6.7	374.26	23.45
5 to 6	67.64	5.1	372.02	28.05
7 to 8	57.14	5.1	428.55	38.25
9 to 10	42.85	4.6	407.08	43.70

As will be noted in table 3, consumption per person did not decrease at a constant rate as size of family increased, apparently because of age distribution in families of various sizes. Small families had a larger percentage of children under 6 years, and consumption per person decreased steadily in families up to those with six members. Consumption per person tended to level off in families of five to eight, but in families with over eight members, consumption per person again began to decrease, probably because more members were eating meals outside the home. The large percentage of the population in the less-than-6-year-old group (20 percent) indicates that per capita consumption may increase as age distribution changes. The relationship between total family consumption and consumption per family member is shown in chart 1.

Chart 1.--Six vegetables: Consumption by size of family; total and per family member.



FAMILY INCOME

Consumption was related to family income, but for various reasons the relationship was not high for the total of six vegetables. The inverse relationship of cabbage consumption and the effects of racial dietary habits were the principal reasons for the low correlation. On the average, an increase of $100 a month in family income was associated with an increased consumption of only ½ pound of the total of six vegetables (chart 2).

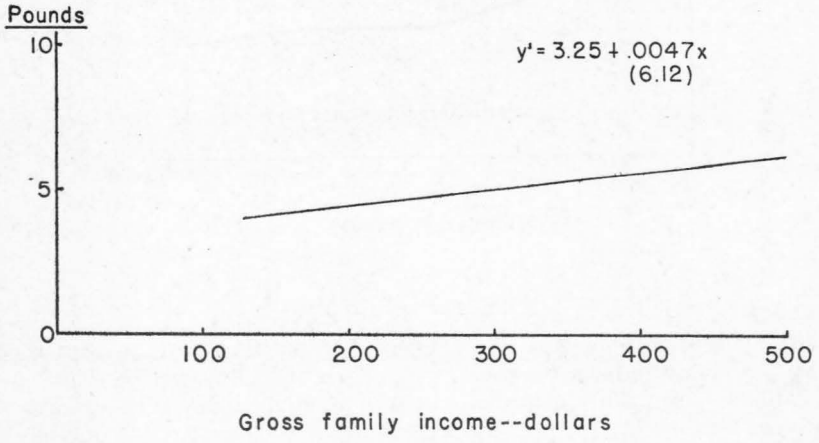
Consumption of each of the six vegetables showed a significant relationship to family income. In the case of the lowest priced vegetable, cabbage, the relationship was inverse—the lower the family income the higher the consumption. In general, an increase of $100 a month in gross family income

was associated with a decrease of 3 pounds of cabbage consumed. Heads of families engaged in semiskilled and skilled service trades had lower average incomes and consumed more cabbage than other groups. Hawaiian, part-Hawaiian, and Filipino families, who average in the lower income groups, also had high rates of cabbage consumption. Similarly, families whose heads had received the least formal education consumed more cabbage. Average family consumption ranged from 8½ pounds a month per family in the "attended grammar school only" category to 5¼ pounds for families whose heads had completed college.

Family consumption of the other five vegetables varied directly with increased family income. Income relationships were sharpest for lettuce and carrots; the effect on the consumption of tomatoes evidently was obscured by racial habits. In general, for an increase of $100 in gross family income, the consumption of lettuce increased 1.3 pounds per month; carrots, 0.9 pounds; tomatoes, 0.5; sweet potatoes, 0.4; and cucumbers, 0.2.

No significant relationships were obtained between consumption of these vegetables and occupation or education of family head. Charts 3 to 8 show the income-consumption relationship for each vegetable as determined by paired observations.

Chart 2.--Six vegetables: Family consumption in relation to gross family income.



RACIAL EFFECTS

As shown in table 4, the mixture of racial influences has had a unique effect on diets. Each race has borrowed menus from the other to the point that 72 percent of families used a mixed diet. Only 5 percent of the Orientals and 3 percent of the Filipinos served purely Oriental diets. Two-thirds of the Caucasian families held to the traditional American eating habits, perhaps because this group contains a larger proportion of newcomers.

Chart 3.--Head cabbage: Family consumption in relation to gross family income.

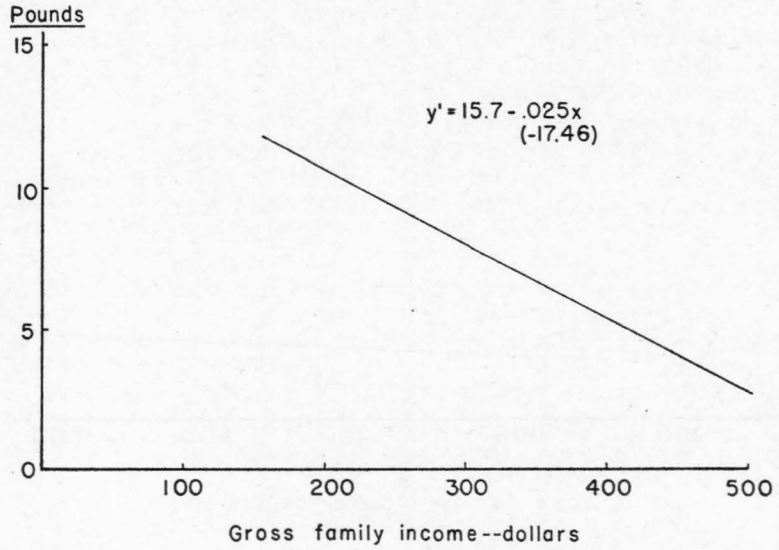


Chart 4.--Tomatoes: Family consumption in relation to gross family income.

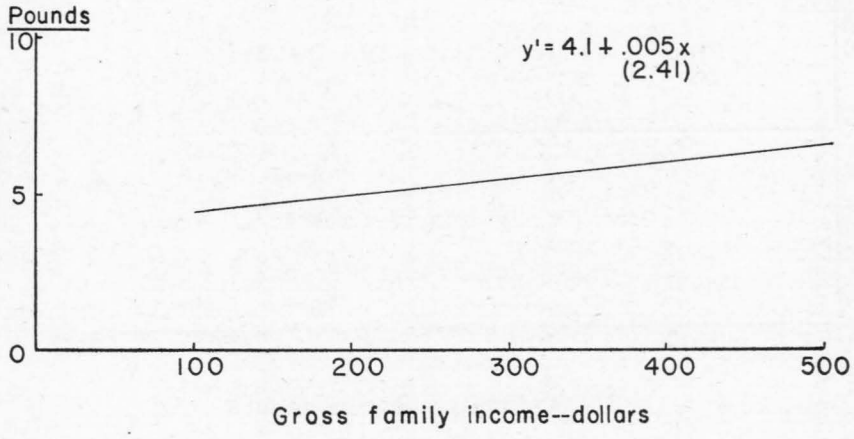


Chart 5.--Cucumbers: Family consumption in relation to gross family income.

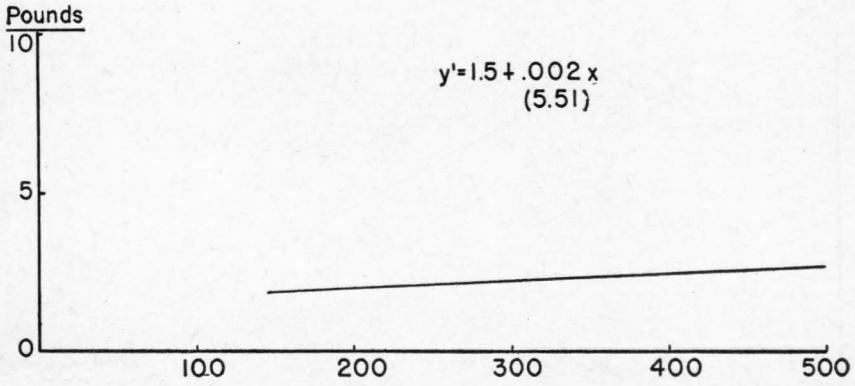


Chart 6.--Head lettuce: Family consumption in relation to gross family income.

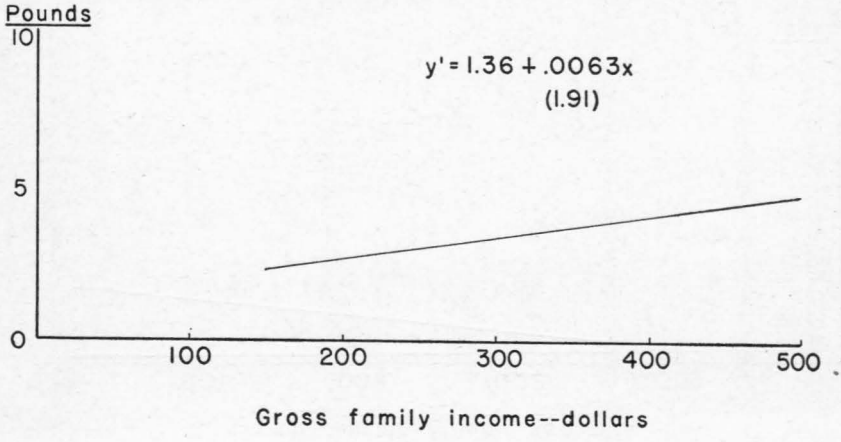


Chart 7.--Carrots: Family consumption in relation to gross family income.

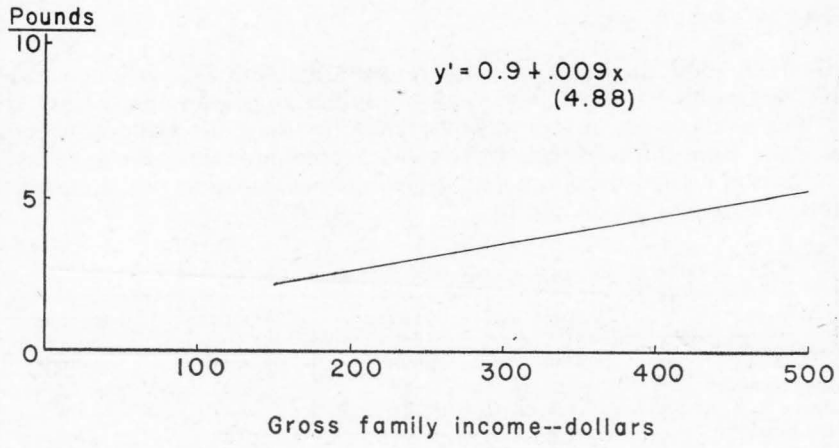


Chart 8.--Sweetpotatoes: Family consumption in relation to gross family income.

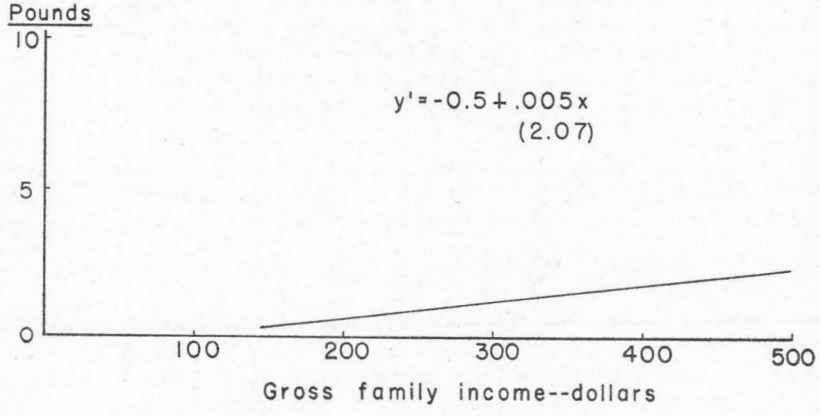


Table 4.—Food habits by racial ancestry.

STYLE OF COOKING	CAUCASIAN	FILIPINO	HAWAIIAN	ORIENTAL
	percent	percent	percent	percent
American	67.2	5.7	13.8	3.8
Oriental	0.4	2.9	0	5.4
Mixture	32.0	85.7	86.2	90.1
Other or don't know	0.4	5.7	0	0.7

However, some distinct racial differences are found in consumption of the six vegetables, as noted in table 5. Filipinos consume more of the six vegetables per person, 6.3 pounds per month, than do Caucasians and Hawaiians. Consumption data for the six vegetables cannot be used as a generalization for consumption of all vegetables because none of the typically Oriental vegetables are in the list.

Table 5.—Per capita consumption per month, by race.

COMMODITY	CAUCASIAN	FILIPINO	HAWAIIAN	ORIENTAL
	pounds	pounds	pounds	pounds
Cabbage, head	1.2	2.0	2.0	1.1
Tomatoes	1.9	2.0	1.4	0.8
Lettuce, head	0.9	0.8	0.5	0.9
Carrots	1.0	0.7	0.6	0.8
Cucumbers	0.6	0.5	0.4	0.4
Sweet potatoes	0.2	0.3	0.3	0.2
Total	5.8	6.3	5.2	4.2

Although Filipinos were in a low-income group, they led in consumption of both low-priced cabbage and high-priced tomatoes. Thus, their high rate of vegetable consumption can be ascribed to dietary customs rather than income. Orientals consumed small quantities of head cabbage in comparison with other groups, but general observation indicates that this is because they eat more of the Oriental types of cabbage than other groups. On the other hand, the low consumption of tomatoes by Orientals is statistically significant as a racial effect. The generally low consumption of the six vegetables by Hawaiians and part-Hawaiians coincides with popular observation on Hawaiian food habits. The exception of cabbage is partially explained as an income effect.

Consumption of lettuce did not increase for the Hawaiian group even when income permitted it. Racial differences in rates of consumption of carrots, cucumbers, and sweet potatoes are not statistically significant (table 9).

USES OF VEGETABLES

The uses that families of different ancestries make of these vegetables shed further light on why consumption varies by race (tables 6 and 7). Most Hawaiian and half of the Oriental families did not use lettuce. Only 72 percent of Caucasian families used cabbage, compared to 98 percent of

Filipino families. Only 35 percent of all families used sweet potatoes, but more than 90 percent used tomatoes and carrots in some manner.

Table 6.—Families who did *not* use certain vegetables, classified by racial ancestry, October, 1951.

RACIAL ANCESTRY	CABBAGE	TOMATO	LETTUCE	CARROT	CUCUMBER	SWEET POTATO
	percent	percent	percent	percent	percent	percent
Caucasian	28	6	32	9	39	69
Filipino	2	3	46	23	26	63
Hawaiian	14	6	62	12	37	64
Oriental	15	8	51	7	28	63
Other	20	0	20	6	27	60
All races	19	7	46	9	33	65

TOTAL CONSUMPTION BY RACIAL ANCESTRY

Income and racial factors naturally affect the total quantities used by each ancestry. The largest group, Orientals, consumed half of the total household supply of lettuce and carrots, but only 31 percent of the tomato supplies (table 7). Caucasians used 23 to 26 percent of the tomatoes, cucumbers, and carrots, but only 15 percent of the cabbage. The Filipino group used about a fifth of the tomatoes and cabbage and only 12 percent of the carrots. Hawaiians used substantial quantities of sweet potatoes, cabbage, and tomatoes, but proportionately less of the other vegetables.

CONSUMER PREFERENCES AND SUBSTITUTIONS

CABBAGE

A medium-size head, of about 2 pounds, was preferred by 57 percent of homemakers. Larger heads were preferred by 15 percent of the families, and 21 percent wanted smaller heads. Firm heads of good quality were a factor in both planned and impulse buying. More than a third of the homemakers gave poor quality in cabbage display as the reason for not buying it as planned. Buying on impulse increased with attractive displays; 18 percent gave this as the reason for making purchases that were not planned before visiting the store.

Island-grown cabbage was preferred over mainland imports by 6 families in 10. Only 1 family in 20 preferred cabbage brought from the mainland. During periods of shortage or of high prices, most families substituted any other green vegetable, but a fourth of the respondents named Chinese cabbage as a desirable substitute, and 8 percent would substitute lettuce. A substantial percentage of Hawaiian and Filipino families, 35 percent, substituted any other vegetable for cabbage. Oriental and Caucasian families, who normally consume less cabbage per capita, were less inclined to substitute other vegetables when prices were high.

TOMATOES

Approximately 50 percent of the homemakers indicated a preference for medium-sized to large, ripe tomatoes. Nearly 80 percent said they preferred to choose from bulk displays rather than from cartons or film bags. Many Honolulu families, 40 percent, preferred island-grown tomatoes but nearly

Table 7.—Families who used certain vegetables, classified by type of use and racial ancestry, October, 1951.

a.—Raw, alone or with other vegetable.

RACIAL ANCESTRY	CABBAGE	TOMATO	LETTUCE	CARROT	CUCUMBER
	percent	percent	percent	percent	percent
Caucasian	21	76	68	14	47
Filipino	15	20	54	3	57
Hawaiian	7	54	38	5	51
Oriental	20	54	49	2	46
Other	13	53	80	7	46
All races	18	60	54	7	47

b.—Cooked, alone or with meat.

RACIAL ANCESTRY	CABBAGE	TOMATO	CARROT	CUCUMBER	SWEET POTATO
	percent	percent	percent	percent	percent
Caucasian	17	2	30	–	31
Filipino	29	9	26	0	37
Hawaiian	36	0	41	0	36
Oriental	20	2	44	1	37
Other	20	0	27	0	40
All races	21	2	38	–	35

– indicates less than 1 percent.

c.—Cooked and raw.

RACIAL ANCESTRY	CABBAGE	TOMATO	CARROT	CUCUMBER
	percent	percent	percent	percent
Caucasian	34	16	47	2
Filipino	54	68	48	3
Hawaiian	43	36	42	4
Oriental	45	35	47	3
Other	47	47	60	0
All races	42	30	46	3

Note: Some uses were made of tomatoes and cucumbers in preparing *lomi-lomi* and *namasu* respectively.

Table 8.—Six vegetables: Share of total family consumption by racial ancestry.

COMMODITY	CAUCASIAN	FILIPINO	HAWAIIAN	ORIENTAL
	percent	percent	percent	percent
Cabbage	15	19	28	38
Tomatoes	26	21	22	31
Lettuce	19	14	13	54
Carrots	23	12	15	50
Cucumbers	24	15	16	45
Sweet potatoes	16	15	23	46

as many bought them because of quality and appearance without regard to origin. Eleven percent gave attractive displays as the reason for making unplanned purchases, and 7 percent said that poor quality was the principal reason for not making planned purchases.

When tomatoes were not available or when prices were unusually high, more than half of the homemakers said they bought any cheaper fresh vegetable; 12 percent chose lettuce, and only 6 percent substituted canned tomatoes.

HEAD LETTUCE

More than half of the homemakers preferred firm heads weighing not more than a pound each. Nevertheless, one-third of the families liked larger heads and one-tenth wanted smaller heads. Quality is apparently very important to homemakers; more than 90 percent of respondents gave poor quality in retail displays as their reason for not buying lettuce after they had planned to do so. More than 10-percent gave good quality, attractively displayed, as the reason for making unplanned purchases. The most common substitute for head lettuce (45 percent) is Manoa (green Mignonette) lettuce. Cabbage was a less common substitute (14 percent). Some indicated a preference for watercress.

CARROTS

In two-thirds of Honolulu households a medium-size (⅓ pound) carrot was preferred and one-fifth of the families liked larger carrots. Only 7 percent wanted smaller carrots, and the remaining 5 percent of homemakers had no preference. Carrots of mainland origin were preferred in 38 percent of households, apparently because of size, shape, color, and similar factors. Thirty percent of the homemakers expressed a preference for island-grown carrots and the remainder were not particular about origin. Ninety percent of the respondents said that poor quality in retail displays was their reason for failing to buy carrots after they had planned to do so. Attractive displays led 10 percent to buy carrots when such purchases had not been planned before entering the store. As substitutes, half of the families bought "any fresh vegetable," 12 percent bought fresh snap beans, and another 12 percent bought a canned vegetable.

CUCUMBERS

Most respondents wanted medium-sized cucumbers. Two-thirds of families preferred island-grown cucumbers, 2 percent liked mainland cucumbers, and 30 percent had no preference as to origin. Respondents did not have a clear opinion of their substitutes for cucumbers.

SWEET POTATOES

The majority of families (70 percent) liked the moist "yam" type sweet potato; 20 percent preferred the dry types, and 10 percent had no preference. Twenty percent of the respondents had no preference as to color of skin, 37 percent liked yellow-skinned types, and 43 percent preferred red types. Thirty percent had no preference as to origin, 25 percent wanted mainland sweet potatoes, and 45 percent preferred the island-grown product. Irish potatoes were named as the principal substitute for sweets.

CANNED AND FROZEN VEGETABLES

Of the families interviewed, 77 percent used canned vegetables, and 35 percent bought the frozen product. Most of those who used frozen vegetables were in the medium- and high-income groups.

STATISTICAL APPENDIX

SAMPLE BIAS AND MEASUREMENT FORMULAE

The questionnaire contained 15 questions for each of the six vegetables, hence interviews were lengthy and fatigue was evident in some of the returns.

1. **Estimate of population total**

Model

L strata or census tracts $h = 1, \ldots, L$

Q_h primary sampling units or enumeration districts

N_{hi} secondary sampling units or dwelling units $i = 1, \ldots, Q_h$

Sample

$q_h = 1$ enumeration district from each census tract

n_{hij} dwelling units from each enumeration district

$$F_{ls} = \sum_{h=1}^{L} Q_h \frac{N_{hi}}{n_{hij}} \sum_{j=1}^{n_{hij}} X_{hij}$$

Where X_{hij} is the value on some population parameter of the j th dwelling unit in the i th enumeration district of stratum h.

2. **Variance of F_{ls}**

$$S^2_{F_{ls}} = \sum_{h=1}^{L} Q_h N_{hi} (N_{hi} - n_{hij}) \frac{S^2_{hi}}{n_{hij}}$$

$$= \sum_{h=1}^{L} Q_h N_{hi} (N_{hi} - n_{hij}) \sum_{j=1}^{n_{hij}} \frac{(X_{hij} - \bar{X}_{hi})^2}{n_{hij} - 1}$$

Note: The above estimates treat $q_h = 1$. When $q_h = C_i$ $i = 1, 2, 3, \ldots$ both formulas are substantially changed. Treatment of $q_h = 1$ does not indicate the variance between the psu's of stratum h.

The large and varying numbers of tourists and armed service personnel who patronize Honolulu restaurants caused an undetermined upward bias to total and per capita consumption results that was not eliminated.

No block statistics are available for Honolulu and the estimating formulae had to be constructed on the premise that households were sampled unrestrictedly from the enumeration districts. The estimate constructed for this design is given below.

Table 9.—Six vegetables: Analysis of variance of weighted means of purchases for four major racial groups.

ITEM	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
Total of six vegetables			
Means	1,176.5	3	392.17*
Within	82,157	3,209	25.60
Head cabbage			
Means	742.5	3	247.50*
Within	26,476.5	641	41.30
Head lettuce			
Means	420.5	3	140.17*
Within	4,112.5	329	12.50
Carrots			
Means	57.6	3	19.20
Within	12,658.4	671	18.86
Sweet potatoes			
Means	54.1	3	18.03
Within	4,172.9	267	15.63
Cucumbers			
Means	51.7	3	17.23
Within	8,608.3	504	17.08
Tomatoes			
Means	1,346.8	3	448.93*
Within	18,826.2	737	25.54

* Significant at 1 percent level.

REGRESSION ANALYSIS[9]

A. All families, unclassified.

Table 10.—Regression coefficients and t-ratios for total family consumption as a function of total family income.

COMMODITY	a	b	t-RATIO
All vegetables	3.25	.0047	6.12
Head cabbage	15.7	—.025	—17.46
Head lettuce	1.36	.0063	1.97
Carrots	0.9	.009	4.88
Sweet potatoes	—0.5	.004	2.07
Cucumbers	1.5	.002	5.51
Tomatoes	4.1	.005	2.41

[9] Tests for linearity of regression indicate that the closeness of fit was not aided by fitting parabolic type regression lines.

Table 11.—Regression coefficients and t-ratios for family per capita consumption as a function of family per capita income.

COMMODITY	a	b	t-RATIO
All vegetables	0.20	.096	4.05
Head cabbage	3.252	—.0134	—6.29
Head lettuce	0.20	.0132	7.25
Carrots	0.035	.018	9.72
Sweet potatoes	0.033	.0202	6.95
Cucumbers	0.001	.010	5.68
Tomatoes	—0.012	.021	7.33

B. Families classified by racial extraction.

Table 12.—Regression coefficients and t-ratios for family per capita consumption as a function of family per capita income.

RACIAL ANCESTRY AND COMMODITY	a	b	t-RATIO
Orientals			
All vegetables	0.26	.016	10.70
Head cabbage	2.50	—.011	—2.89
Head lettuce	0.22	.0139	4.31
Carrots	0.071	.013	8.02
Sweet potatoes	0.029	.0151	5.81
Cucumbers	0.044	.0146	5.11
Tomatoes	—0.34	.0199	12.39
Caucasians			
All vegetables	0.301	.0102	5.78
Head cabbage	2.65	—.0085	—2.18
Head lettuce	1.07	.011	10.26
Carrots	0.056	.013	8.07
Sweet potatoes	0.018	.016	14.17
Cucumbers	0.017	.004	1.83
Tomatoes	0.85	.011	8.43
Hawaiians			
All vegetables	0.157	.0113	6.93
Head cabbage	4.64	—.0064	—3.34
Head lettuce	0.78	.006	1.77*
Carrots	0.04	.018	9.83
Sweet potatoes	—0.26	.026	— *
Cucumbers	—0.25	.025	2.45
Tomatoes	1.00	.009	3.02
Filipino			
All vegetables	0	.0321	6.69
Head cabbage	0.76	.0193	4.26
Head lettuce	1.11	.002	0.26*
Carrots	0.55	.016	3.86
Sweet potatoes	0.40	.0006	0.06*
Cucumbers	0.025	.021	2.32
Tomatoes	—1.18	.06	10.40

* Not significant at 5 percent level.

C. Families classified by number in family.

Table 13.—Regression coefficients and t-ratios for family per capita consumption as a function of number in family for selected vegetables.

COMMODITY	a	b	t-RATIO
Carrots	3.58	—0.27	—4.35
Sweet potatoes	3.68	—0.31	—3.48
Cucumbers	2.74	—0.18	—3.39
Tomatoes	3.48	—0.29	—0.96*

* Not significant at 5 percent level.

Table 14.—Income-consumption elasticities* for certain vegetables in Honolulu, October, 1951.

COMMODITY	ELASTICITY
Six survey vegetables combined	0.963
Head cabbage	—0.538
Head lettuce	0.513
Carrots	0.79
Sweet potatoes	0.923
Cucumbers	0.597
Tomatoes	1.026

* Measured at the centroid.

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